SIDDARTH GROUP OF INSTITUTIONS :: PUTTUR
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: NUMERICAL METHODS ANDTRANSFORMS (19HS0834)
Branch: B.Tech. (ECE) **Year &Sem:** II-B.Tech. & I-Sem. **Regulation:** R19

UNIT –I

1. Find out the square root of 25 given $x_0 = 2.0,\ x_1 = 7.0$ using Bisection method. [12M]

2. Find a positive root of $x^3 - x - 1 = 0$ correct to two decimal places by Bisection method. [12M]

3. Find a positive root of $f(x)=e^x - 3$ correct to two decimal places by Bisection method. [12M]

4. Find a real root of the equation $xe^x - \cos x = 0$ using Newton – Raphson method. [12M]

5. Using Newton-Raphson method (i) Find square root of 28 (ii) Find cube root of 15. [12M]

6. a) Using Newton-Raphson method Find reciprocal of 12. [6M]

   b) Find a real root of the equation $x\tan x + 1 = 0$ using Newton – Raphson method. [6M]

7. Find out the root of the equation $x\log_{10}(x)=1.2$ using False position method. [12M]

8. Find the root of the equation $xe^x = 2$ using Regula-falsi method. [12M]

9. From the following table values of x and $y=\tan x$. Interpolate values of y when $x=0.12$ and $x=0.28$.

x	0.10	0.15	0.20	0.25	0.30
y	0.1003	0.1511	0.2027	0.2553	0.3093

[12M]

10. a) Using Newton’s forward interpolation formula and the given table of values

x	1.1	1.3	1.5	1.7	1.9
$f(x)$	0.21	0.69	1.25	1.89	2.61

Obtain the value of $f(x)$ when $x=1.4$. [6M]

b) Use Newton’s backward interpolation formula to find $f(32)$ given $f(25)=0.2707$, $f(30)=0.3027$, $f(35)=0.3386$, $f(40)=0.3794$. [6M]

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UNIT –II

1. Tabulate y(0.1), y(0.2) and y(0.3) using Taylor's series method given that $y^1 = y^2 + x$ and y(0) = 1 [12M]
2. Using Taylor's series method find an approximate value of y at x = 0.2 for the D.E y^1- 2y = $3e^x$, y(0) = 0.Compare the numerical solution obtained with exact solution. [12M]
3. a) Solve $y^1 = x + y$, given y (1)=0 find y(1.1) and y(1.2) by Taylor's series method. [6M]
   b) Solve by Euler's method $\frac{dy}{dx} = \frac{2y}{x}$ given y(1)=2 and find y(2) [6M]
4. Using Euler's method, find an approximate value of y corresponding to $x = 1$ given that $\frac{dy}{dx} = x + y$ and $y = 1$ when $x = 0$ taking step size $h = 0.1$ [12M]
5. a) Using Euler's method $y' = y^2 + x$, y(0)=1. Find y(0.1) and y(0.2) [6M]
   b) Using Runge – Kutta method of fourth order, compute y(0.2) from $y^1 = xy$ y(0)=1, taking h=0.2 [6M]
6. Using R-K method of 4^{th} order, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$, y(0)=1. Find y(0.2) and y(0.4) . [12M]
7. Using R-K method of 4^{th} order find y(0.1), y(0.2) and y(0.3) given that $\frac{dy}{dx} = 1 + xy, y(0) = 2.$ [12M]
8. Solve $y'' - x(y')^2 + y^2 = 0$ using R-K method of 4^{th} order for $x = 0.2$ given y(0) = 1, and $y^1(0)$=0 taking h=0.2 [12M]
9. Evaluate $\int_0^1 \frac{1}{1+x}dx$ (i) by Trapezoidal rule and Simpson's $\frac{1}{3}$ rule.
   (ii) using Simpson's $\frac{3}{8}$ rule and compare the result with actual value. [12M]
10. a) Compute $\int_0^4 e^x dx$ by Simpson's $\frac{3}{8}$ rule with 12 sub divisions. [6M]
    b) Compute $\int_3^7 x^2 \log x dx$ using Trapezoidal rule and Simpson's $\frac{1}{3}$ rule by taking 10 sub divisions. [6M]

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UNIT-III

1. a) Find the Laplace transform of $f(t) = e^{3t} - 2e^{-2t} + sin2t + cos3t + sinh3t - 2cosh4t + 9$. [6M]

   b) Find the Laplace transform of $f(t) = cosh\ at\ sin\ bt$. [6M]

2. a) Find the Laplace transform of $f(t) = \left(\sqrt{t} + \frac{1}{\sqrt{t}}\right)^3$. [6M]

   b) Find the Laplace transform of $f(t) = e^{4t} sin2t\ cost$. [6M]

3. a) Find the Laplace transform of $f(t) = t^2 e^{2t} \sin 3t$. [6M]

   b) Find the Laplace transform of $f(t) = \dfrac{1 - \cos at}{t}$. [6M]

4. a) Find the Laplace transform of $f(t) = \int_0^t e^{-t} \cos t\, dt$. [6M]

   b) Find the Laplace transform of $f(t) = e^{-4t} \int_0^t \frac{\sin 3t}{t} dt$. [6M]

5. a) Show that $\int_0^\infty t^2 e^{-4t} .\sin 2t\, dt = \frac{11}{500}$, Using Laplace transform. [6M]

   b) Using Laplace transform, evaluate $\int_0^\infty \frac{\cos at - \cos bt}{t} dt$. [6M]

6. a) Find $L^{-1}\left\{\frac{3s-2}{s^2 - 4s + 20}\right\}$ by using first shifting theorem. [6M]

   b) Find $L^{-1}\left\{\log\left(\frac{s-a}{s-b}\right)\right\}$ [6M]

7. a) Find $L^{-1}\left\{\frac{1}{(s^2 + 5^2)^2}\right\}$, using Convolution theorem. [6M]

   b) Find $L^{-1}\left\{\frac{s^2}{(s^2 + 4)(s^2 + 25)}\right\}$, using Convolution theorem. [6M]

8. a) Find the Inverse Laplace transform of $\frac{1}{s(s^2 + a^2)}$ [6M]

   b) Find $L^{-1}\left\{s \log\left(\frac{s-1}{s+1}\right)\right\}$ [6M]

9. Using Laplace transform method to solve $y^{11} - 3y^1 + 2y = 4t + e^{3t}$ where $y(0) = 1, y^1(0) = 1$ [12M]

10. Solve the D.E. $\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + x = 3te^{-t}$ using Laplace Transform given that $x(0) = 4; \frac{dx}{dt} = 0.at, t = 0$ [12M]

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UNIT – IV

1. a) Obtain the Fourier series expansion of f(x) = x^2 in the interval$(0,2\pi)$. [6M]

   b) Obtain the Fourier series expansion of f(x) =$(x - x^2)$ in the interval $[-\pi,\pi]$. Hence show that $\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}-----=\frac{\pi^2}{12}$. [6M]

2. a) Obtain the Fourier series expansion of $f(x) = (\pi - x)^2$ in $0 < x < 2\pi$ and deduce that $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\frac{1}{4^2}-----=\frac{\pi^2}{6}$. [6M]

   b) Find the Fourier series for the function $f(x) = x$; in -π < x < π . [6M]

3. Find a Fourier series to represent the function $f(x) = e^x$ for $-\pi < x < \pi$. And hence deduce the series for $\frac{\pi}{sinh\pi}$. [12M]

4. Find the Fourier series to represent the function $f(x) = x^2$ for $-\pi < x < \pi$ and hence show that

   (i)$\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}-----=\frac{\pi^2}{12}$. (ii)$\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\frac{1}{4^2}-----=\frac{\pi^2}{6}$.

   (iii) $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\frac{1}{7^2}-----=\frac{\pi^2}{8}$ [12M]

5. a) If $f(x)=|\sin x|$, expand f(x) as a Fourier series in the interval $(-\pi,\pi)$ [6M]

   b) Find the half range cosine series for $f(x) = x$ in the interval $0\le x \le \pi$. [6M]

6. Expand the function $f(x) = |x|$ in $-\pi < x < \pi$ as a Fourier series and deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\frac{1}{7^2}-----=\frac{\pi^2}{8}$ [12M]

7. Find the half range sine series for $f(x) = x(\pi - x)$ in the interval $0\le x \le \pi$ and deduce that $\frac{1}{1^3}-\frac{1}{3^3}+\frac{1}{5^3}-\frac{1}{7^3}-----=\frac{\pi^3}{32}$. [12M]

8. a) Expand $f(x) = e^{-x}$ as a fourier series in the interval $(-1,1)$. [6M]

   b) Expand $f(x) = |x|$ as a fourier series in the interval $(-2,2)$. [6M]

9. a) Find the half range sine series expansion of $f(x) = x^2$ when $0 < x < 4$. [6M]

   b) Find the half range cosine series expansion of $f(x) = x(2 - x)$ in $0 \le x \le 2$. [6M]

10. Find half range Fourier cosine series of $f(x) = (x - 1)^2$ in $0 < x < 1$.

    Hence show that $i)$ $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\frac{1}{4^2}-----=\frac{\pi^2}{6}$ $ii)$ $\sum_{n=1}^{\infty}\frac{(-1)^{n+1}}{n^2}=\frac{\pi^2}{12}$. [12M]

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UNIT – V

1. Find the Fourier transform of f(x) $=\begin{Bmatrix} 1; |x| < a \\ 0, |x| > a \end{Bmatrix}$ and hence evaluate

   $i)\ \int_{-\infty}^{\infty} \frac{sinap\ cospx}{p} dp \quad ii)\ \int_{-\infty}^{\infty} \frac{sinp}{p} dp \quad iii)\ \int_{0}^{\infty} \frac{sinp}{p} dp.$ [12M]

2. Find the Fourier transform of f(x) $=\begin{Bmatrix} a^2 - x^2, |x| < a \\ 0, |x| > a > 0 \end{Bmatrix}$ Hence show that $\int_0^\infty \frac{\sin x - x\cos x}{x^3} dx = \frac{\pi}{4}$. [12M]

3. a) Find the Fourier transform of f(x) =. $e^{-\frac{x^2}{2}}, -\infty < x < \infty$ [6M]

   b) If F(p) is the complex Fourier transform of f(x) , then prove that the complex Fourier transform of f(x) = $cosax$ is $\frac{1}{2}[F(p+a) + F(p-a)]$ [6M]

4. a) Find the Fourier cosine transform of f(x) defined by $f(x) = \begin{cases} cosx & ; 0 < x < a \\ 0 & ; x \geq a \end{cases}$ [6M]

   b) If F(P) is the complex Fourier transform of f(x) , then prove that the complex Fourier transform of $F\{f(x-a)\} = e^{ipa}.F(P)$ [6M]

5. Find the Fourier sine and cosine transforms of f(x)=$\frac{e^{-ax}}{x}$ and deduce that

   $\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x} \sin sx\, dx = \tan^{-1}\left(\frac{s}{a}\right) - \tan^{-1}\left(\frac{s}{b}\right).$ [12M]

6. Find the Fourier sine and cosine transforms of f(x)=$e^{-ax}, a > 0$ and hence deduce the integrals [12M]

   (i) $\int_0^\infty \frac{p\sin px}{a^2 + p^2} dp$ (ii) $\int_0^\infty \frac{\cos px}{a^2 + p^2} dp$

7. a) Prove that F[x^n f(x)] = $(-i)^n \frac{d^n}{dp^n}[F(p)]$ [6M]

   b) Prove that F_s { x f(x) } = $-\frac{d}{dp}[F_c(p)]$ [6M]

8. a) Find the Fourier cosine transform of $e^{-ax} \cos ax, a > 0$ [6M]

   b) Find the Fourier cosine transform of f(x) = $\begin{Bmatrix} x,\ for\ 0 < x < 1 \\ 2 - x,\ for\ 1 < x < 2 \\ 0,\ for\ x > 2 \end{Bmatrix}$ [6M]

9. Find the finite Fourier sine and cosine transform of f(x) defined by $f(x) = 2x\ \ where\ 0 < x < 2\pi$. [12M]

10. a) Find the finite Fourier sine transform of f(x),defined by $f(x) = \begin{Bmatrix} x,\ 0 \leq x \leq \frac{\pi}{2} \\ \pi - x,\ \frac{\pi}{2} \leq x \leq \pi \end{Bmatrix}$ [6M]

    b) Find the inverse finite Fourier sine transform of f(x), If F_s(n) = $\frac{16(-1)^{n-1}}{n^3}$, where n is a positive integer and 0 < x < 8. [6M]